

REMARKS

Claims 1-3, 20, and 21 are pending. Upon entry of the present response, claims 1-3 and 20-22 will be pending, claims 1, 3, and 21 having been amended, claim 22 added, and claim 20 withdrawn in the present response.

103 Rejections

Claims 1-3 and 21 were rejected under 35 U.S.C. 103(a) as being unpatentable over Misiano (U.S. Patent 5,462,779), Imai (U.S. Patent 5,378,506), or Matsuda (JP 06-330318). Applicants traverse the rejections.

Applicants have discovered through extensive experimentation that the claimed film of embodiments of the present invention has improved flexibility, excellent gas barrier properties of the inorganic oxide layer, and excellent transparency because of the ratio of 1.5 between the maximum and minimum thicknesses of the inorganic oxide layer. These unexpected results of the claimed film have been previously demonstrated in at least the Responses filed December 2, 2003 and February 24, 2005. Outside this ratio of 1.5, film flexibility decreases in thicker portions, there is risk of film cracking in thinner portions, and the gas barrier properties deteriorate. Hence, films that are outside this ratio are not practical.

Applicants conducted the following experiments to demonstrate that the claimed film is superior to the films of Misiano, Imai, and Matsuda with respect to mass production, for example.

Prior to Applicants' invention, monitoring and control of film layer thickness in both the machine direction (MD) and the transverse direction (TD) has not been done for reducing variation in thickness. Applicants discovered that, in a roll to roll method, where material is vapor deposited on a roll film while the film is being unrolled, monitoring the film layer thickness in both MD and TD is needed in order to control the thickness of the vapor deposited layer of the film. Applicants have examined, *inter alia*, installing a film layer thickness monitor, monitoring film layer thickness in the MD and TD, arranging the materials to be vapor deposited, and controlling film heating in order to reduce layer thickness variations.

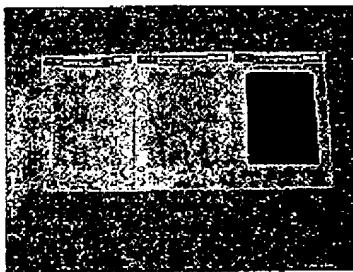
Misiano discloses a film with an Al_2O_3 - SiO_2 layer, in which the thickness of the layer is not controlled at all. Similarly, Imai discloses a film with a MgO layer, in which the layer thickness is not controlled at all.

Matsuda discloses a film with a SiO_x layer, in which the thickness of the layer is monitored in the MD using a fluorescent x-ray monitor. See Matsuda, ¶0038. However, there is no mention of monitoring the thickness of the layer in the TD.

As discussed in previous Responses to Office Action, a method at the time of Misiano controlled film layer thickness of vapor deposited aluminum by monitoring thickness in the TD using an optical monitor. Applicants demonstrated that this control method was not successful in reducing the variations in film layer thickness, as in the claimed ratio of 1.5 in the present invention. Therefore, since a method that uses some control can not reach the claimed ratio, the films of Misiano and Imai, which use no control, and the film of Matsuda, which uses control in only one direction, are also highly unlikely to reach the claimed ratio. The following experiments demonstrate this point.

Using an optical monitor, Applicants conducted experiments to try to control the film thickness of Al_2O_3 - SiO_2 , SiO_x , and vapor deposited aluminum layers on a film shown in the photograph in Figure 1 (from left to right). The Al_2O_3 - SiO_2 layer is colorless and transparent, the SiO_x layer is slightly colored, and the vapor deposited aluminum layer is not transparent.

Figure 1.



In order for optical monitoring to effectively control the film layer thickness, there must be some way to disrupt the light passing through the film proportional to the film layer thickness so as to determine the layer thickness. As shown in Figures 2 and 3, a business card placed beneath the films covered with Al_2O_3 - SiO_2 and SiO_x layers, respectively, can be seen through the films, such that there would be little or no light

disruption from which to monitor and control the film layer thickness. Whereas, in Figure 4, a business card placed beneath the film covered with vapor deposited aluminum can not be seen through the film at all, such that there would be almost total light disruption for any deposition within the claimed range, thus making differentiation between different film layer thicknesses difficult.

Figure 2.

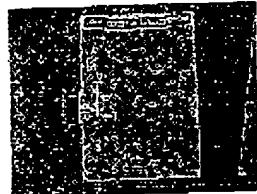


Figure 3.

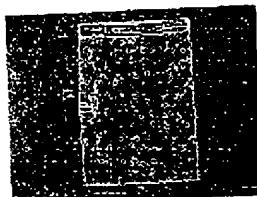
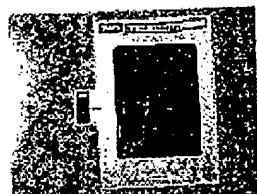


Figure 4.



Figures 5-7 show similar results for the three film layers, in which a fluorescent light is seen, though blurred due to haze, through the Al_2O_3 - SiO_2 and SiO_x layers in Figures 5 and 6 and in which a fluorescent light can be seen through the vapor deposited aluminum layer with much less light in Figure 7.

Figure 5.



Figure 6.



Figure 7.



These results show that it would be difficult to control the film layer thickness of a film by monitoring thickness in one direction, such as in Matsuda, and even more difficult when there is no control at all, such as in Misiano and Imai.

Applicants conducted further experiments on a film having a width of 900 mm and a length of 16,000 m, with an Al₂O₃-SiO₂ based material deposited thereon, in accordance with the method of Matsuda, in which the thickness of the deposition layer was not monitored or controlled in the TD. In the experiments, Applicants targeted a film deposition layer thickness of 20 nm and a target layer composition of 40 wt%.

Table 1 shows the distribution of the film deposition layer thickness in the MD and TD of the film produced according to the method of Matsuda.

Table 1.

Machine Direction (MD), mm	Transverse Direction (TD), m																
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000	16000
-450	13	14	14	14	13	14	12	14	12	14	15	12	13	14	12	12	15
-300	17	17	18	18	16	17	17	15	17	16	18	18	16	17	19	17	16
0	17	19	20	20	19	19	18	19	19	20	21	19	19	20	18	20	19
300	12	14	14	13	14	14	13	14	13	15	14	14	14	15	15	14	19
450	10	11	11	10	11	11	9	10	10	10	11	10	11	11	11	10	15

As shown in Table 1, while some sections of the film (highlighted) have thicknesses close to the target thickness of 20 nm, the majority of the sections have

thicknesses that are outside the target thickness and that vary significantly from section to section. This demonstrates that a Matsuda film is unlikely to have a layer thickness ratio of 1.5 along the width and length of the film, as in the claimed film of the present invention.

Figure 8 shows a three-dimensional distribution of film deposition layer thickness in the MD and TD of the film produced according to the method of Matsuda. Figure 9 shows the distribution of film deposition layer thickness in the TD for respective points in MD.

As shown in Figures 8 and 9 below, a high level of uniformity of film layer thickness over a great width and a great length of the film can not be achieved in a film produced according to a method of Matsuda. Monitoring the film thickness in the MD alone cannot make the film layer thickness uniform because uniformity along the MD does not necessarily ensure uniformity along the TD, which is not monitored in Matsuda.

Figure 8.

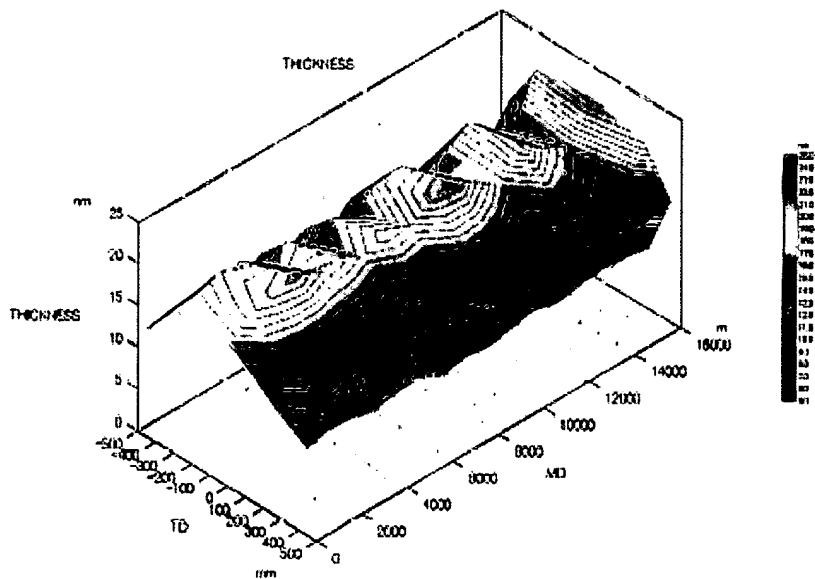
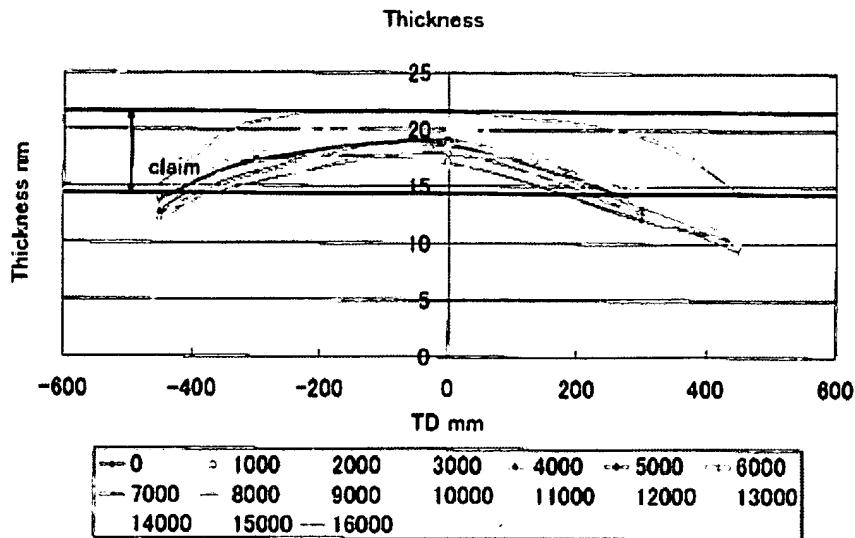


Figure 9.



For at least the above reasons, Applicants submit that the unexpected results of the claimed film layer thickness ratio of 1.5 is neither taught nor suggested by Misiano, Imai, or Matsuda. Hence, claims 1-3 and 21 are not believed to be obvious over these references. Withdrawal of the rejections is therefore requested.

New claim 22

For at least the above reasons, new claim 22 is also not believed to be obvious over the cited references.

CONCLUSION

It is respectfully submitted that the present application is now in condition for allowance, which action is respectfully requested.

The Examiner is invited to contact Applicants' representative to discuss any issue that would expedite allowance of the subject application.

The Commissioner is authorized to charge any required fees or to credit any overpayment to Kenyon & Kenyon's Deposit Account No. 11-0600.

Respectfully submitted,
KENYON & KENYON

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